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IDENTIFIERS *Vocational Education Readiness Test

ABSTRACT

Focusing on basic welding, this module is one of eight included in the Vocational Education Readiness Test (VERT). The module begins by listing the objectives of the module and describing tools and equipment needed. The remainder of the module contains sections on manipulative skills, trade vocabulary, tool identification, trade computation skills, and measuring skills depicted as minimum competencies students should possess prior to entrance into regular secondary vocational education programs. (A user's guide is also available--see note.) (LRA)

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ED 2000829

Module 2 of the Vocational Education Readiness Test (VERT)

BASIC WIRING

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BASIC WIRING

Objective(s):

1. To determine student's ability to measure in inches, half-inches, quarter-inches and eighth-inches.
2. To determine student's ability to use a crimper/stripper tool as a wire cutter.
3. To determine student's ability to use a crimper/stripper tool as a bolt cutter.
4. To determine student's ability to use a crimper/stripper tool as a wire stripper.
5. To determine student's ability to make a pigtail splice with #12/2 insulated wire using a lineman's pliers.
6. To determine student's ability to insulate wires using PVC electrical tape.
7. To determine student's ability to splice wires using insulated plastic solderless connectors.
8. To determine student's ability to connect #6 single cables with solderless type B connectors.
9. To determine student's ability to wire a single pole wall switch.
10. To determine student's ability to wire a ceiling fixture.
11. To determine student's ability to wire a wall receptacle.

Tools Needed: (See Appendix A for the electrical wiring mock-up and Appendix B for the entrance cable mock-up.)

One Crimper/stripper tool

Four lengths of #12/2 cable (approx. 12")

One roll PVC electrical tape

Lineman's pliers

One machine bolt (10/24) (approx. 2")

One straight blade screwdriver (1/4")

Slip joint pliers

Two insulated plastic solderless connectors on power feed apparatus

Two type "B" solderless connectors

Two lengths of #6 insulated cable

One ceiling outlet (box), attached to mock-up

Two standard wall outlet boxes w/covers, attached to mock-up

One porcelain base ceiling fixture

One single pole wall switch

One duplex wall receptacle

Three lengths of #12/2 cable (for electrical mock-up box)

One needlenose pliers

One diagonal cutting pliers

One straight blade 3/16" screwdriver

One power feed apparatus (part of kit)

12" plastic ruler

Preliminary Exercise:

The evaluator will identify a 12" plastic rule and demonstrate how to measure to the nearest inch, half-inch, quarter-inch, and eighth-inch. Answer any questions at this time; however, avoid "teaching" the student to measure by giving repeated demonstrations. (See Figure 1.)

Special Instructions: Lines for Tasks 1 - 4 should measure 3", 3 1/2", 3 1/4", and 3 1/8", respectively, and should be drawn on a separate sheet of paper.



Figure 1.

Task 1: _____ •

Task 2: _____ •

Task 3: _____ •

Task 4: _____ •

Tasks 1 through 4

Given a 12" plastic rule and measuring tasks 1, 2, 3, and 4, the student will measure the line in each task and tell his/her findings to the evaluator.

*Lines are drawn on separate sheet to respective length by evaluator.

Preliminary Exercise:

The evaluator will identify the crimper/stripper tool and demonstrate its use as a cable cutter. (See Figure 2.)

Special Instructions: Wear safety glasses!

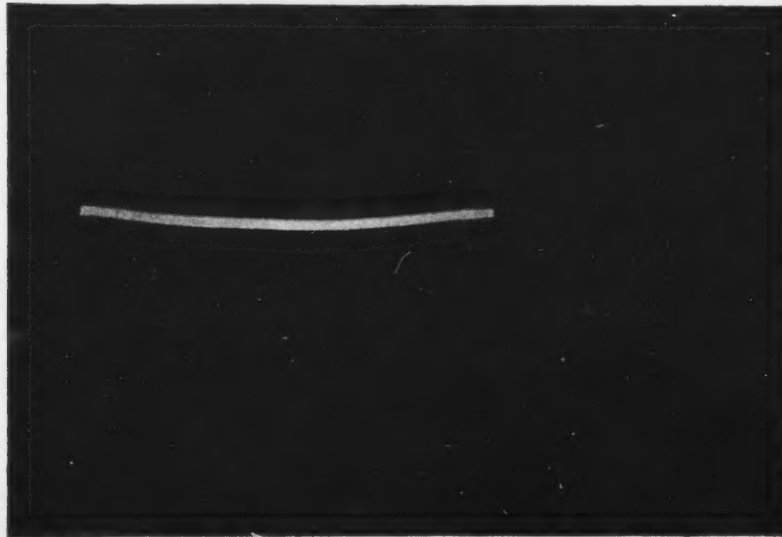


Figure 2.

Task 5

Given a crimper/stripper tool and one length of #12/2 cable approximately 12" long, the student will cut off approximately 1" of cable. **Note time!**

Preliminary Exercise:

The evaluator will demonstrate how to use the crimper/stripper tool as a bolt cutter. (See Figure 3.)

Special Instructions: Caution student concerning Task 6. If crimper/stripper tool is held incorrectly, a student's finger or fingers could be severely cut. Wear safety glasses!

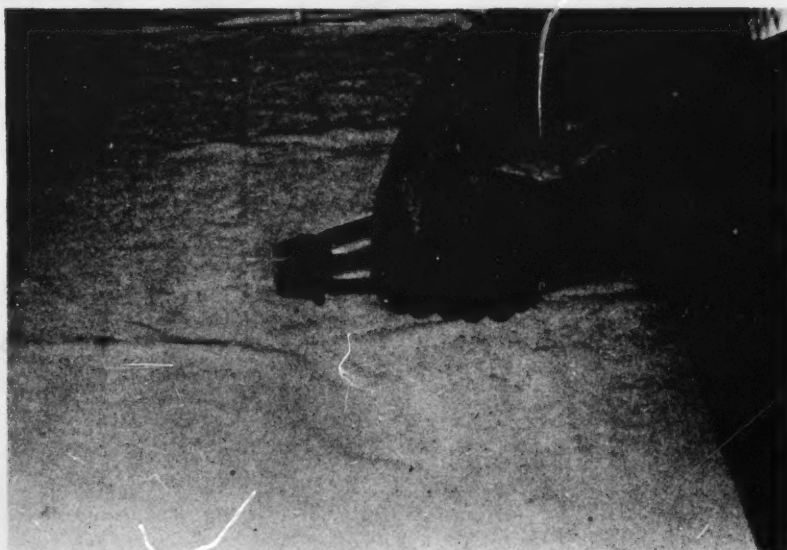


Figure 3.

Task 6

Given a crimper/stripper tool, screwdriver, and one machine bolt (#24), the student will screw the bolt into the proper size threaded hole on the cutters as indicated to a distance of approximately 1/4" and using both hands will cut the bolt. **Note time!**

Preliminary Exercises:

The evaluator will demonstrate how to use the crimper/stripper tool to strip wire. (See Figure 4.)

Special Instructions: Wear safety glasses!

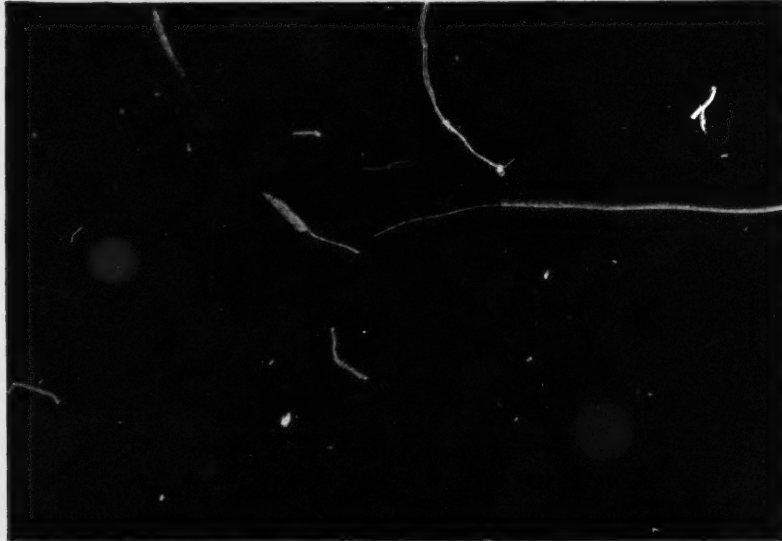


Figure 4.

Task 7

Given a crimper/stripper tool and two lengths of #12/2 cable with the outer cable insulation removed for 3", the student will cut and strip approximately 1½" of insulation from the black wire and 1½" from the white wire. **Note time!**

Preliminary Exercise:

The evaluator will use two lengths of #12/2 cable and lineman's pliers and demonstrate how to make a pigtail splice. (See Figure 5.)

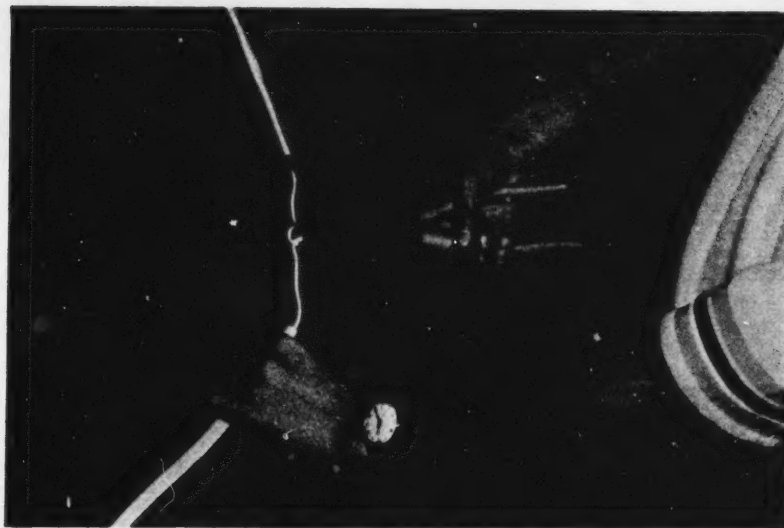


Figure 5.

Task 8

Given two lengths of #12/2 cable (used in task #7) and lineman's pliers, the student will splice (pigtail) black wire to black wire and white wire to white wire, and cut the ends of each splice to the same length. **Note time!**

Preliminary Exercise:

The evaluator will identify a roll of PVC electrical tape and demonstrate how to insulate spliced wires with electrical tape. (See Figure 6.)



Figure 6.

Task 9

Given the spliced cable used in task #8 and a roll of PVC electrical tape, the student will tape the two splices. **Note time!**

Preliminary Exercise:

The evaluator will identify two insulated plastic solderless connectors and demonstrate how to connect wires using plastic connectors. (See Figure 7.)



Figure 7.

Task 10

Given the spliced wires used in task #9, the student will remove the tape and will screw (by hand) two insulated plastic solderless connectors over the splices. **Note time!**

Preliminary Exercise:

The evaluator will identify two #6 insulated cables, one type-B solderless (noninsulated) connector, power feed apparatus, and slip joint pliers, and will demonstrate how to connect power feed lines using the type-B solderless connector. (See Figure 8)

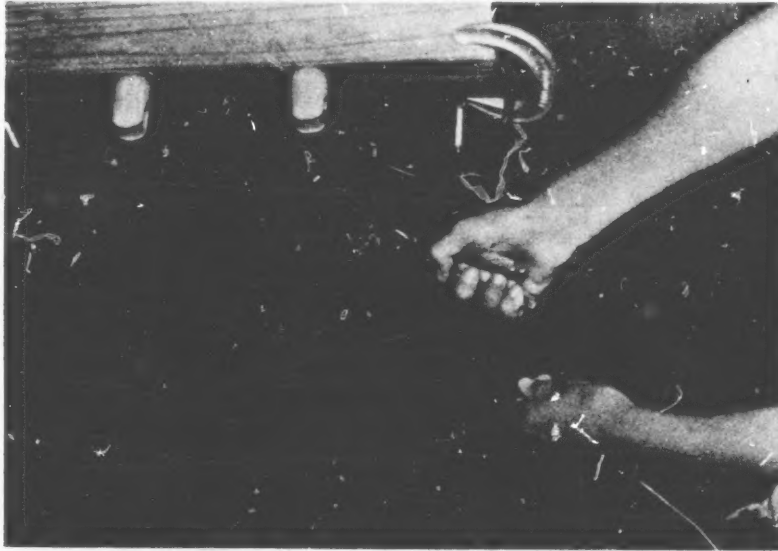


Figure 8.

Task 11

Given two #6 insulated cables, one type-B solderless connector, slip joint pliers, and power feed apparatus, the student will tie the cable to the insulator on the power feed apparatus and join the two cable ends with a type-B connector. **Note time!**

Preliminary Exercise:

The evaluator will identify a single pole wall switch and outlet box and will demonstrate how to wire the wall switch. (See Figure 9.)

Special Instructions: Wires must be cut and stripped for each student. Instruct the student to use the 1/4" screwdriver on cover and a 3/16" screwdriver for terminal screws and screws attaching wall switch to outlet box.



Figure 9.

Task 12

Given a wall switch, cover, outlet box, #12/2 cable, 3/16" and 1/4" straight blade screwdrivers and needlenose pliers, the student will bend the black and white wires and attach them to the terminal screws on the wall switch, attach the wall switch to the outlet box, and place cover on the box. **Note time!**

Additional Note: You may wish to construct a simulated wall and ceiling with a wall switch, ceiling fixture, and duplex wall receptacle in place of the wiring mockup used in Figures 9, 10, and 11. This would force the student to work overhead, in a kneeling position, etc.

Preliminary Exercise:

The evaluator will identify a porcelain ceiling fixture and square outlet box and will demonstrate how to wire the fixture. (See Figure 10.)

Special Instructions: Wires must be cut and stripped for each student. Use 1/4" screwdriver.



Figure 10.

Task 13

Given a porcelain ceiling fixture, square outlet box, #12/2 cable, needlenose pliers, and 1/4" common screwdriver, the student will attach the black wire to the dark terminal screw and the white wire to the light terminal screw and attach the fixture to the ceiling outlet box. **Note time!**

Preliminary Exercise:

The evaluator will identify a duplex wall receptacle cover and outlet box, and will demonstrate how to attach the wires to the quick-wire receptacle. (See Figure 11.)

Special Instructions: Use a standard 3/16" screwdriver for cover and a standard 1/4" screwdriver for attaching receptacle to outlet box.

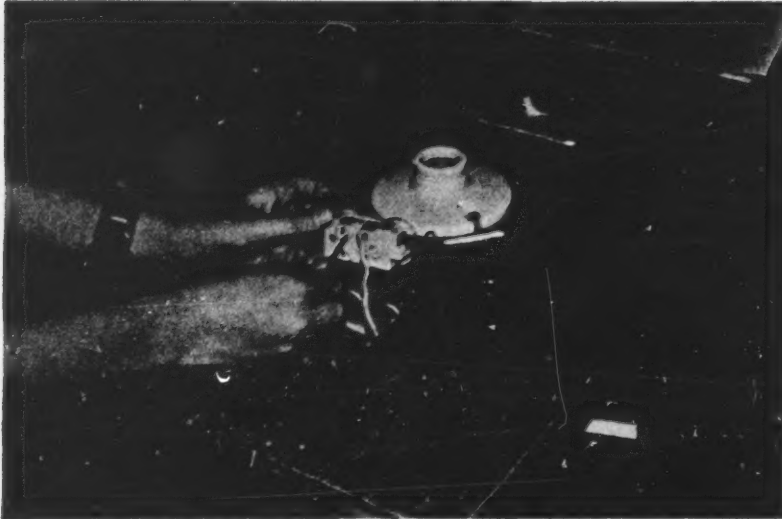


Figure 11.

Task 14

Given a duplex wall receptacle, cover, outlet box, #12/2 cable, and 3/16" and 1/4" screwdrivers, the student will insert the white wire in the white wire opening on the quick-wire wall receptacle, the black wire in the other quick-wire opening, attach receptacle to the outlet box, and attach cover. **Note time!**

VOCATIONAL EDUCATION READINESS TEST (VERT)
SCORING RESULTS SHEET FOR BASIC WIRING

(Example Only)

Name _____

Student Performance Data

	Time*				
	Acceptable	Unacceptable			
			**Cut-Off Time (Seconds)		
Task 1	_____	_____	(1/2")	X	Measure- ment Skills
Task 2	_____	_____	(1/4")	X	
Task 3	_____	_____	(1/8")	X	
Task 4	_____	_____	(1/16")	X	
Task 5	_____	_____	20		
Task 6	_____	_____	195		
Task 7	_____	_____	45		
Task 8	_____	_____	150		
Task 9	_____	_____	105		
Task 10	_____	_____	180		
Task 11	_____	_____	75		
Task 12	_____	_____	300		
Task 13	_____	_____	225		
Task 14	_____	_____	180		

*Write N/C should student be unable to complete the task.

**These scores were arbitrarily identified and included for demonstration purposes only.

Vocabulary For Basic Wiring

ADAPTER PLUG: A device for fitting a three-prong plug into a two slot socket.

AMPERE: A unit of electrical current or the amount of current that would flow past a point in a circuit each second.

BALLAST: A part in a fluorescent lamp used to start and stabilize the light.

BAR HANGER: A device for mounting ceiling outlet boxes.

BRANCH CIRCUIT: Wires running from a panel box to a group of outlets.

CABLE (ROMEX): The most common type of wire used in wiring a house.

CABLE CONNECTOR: The hardware used for attaching conduit to an outlet box.

CABLE STRIPPER: A tool for stripping insulation from plastic covered cable.

CIRCUIT BREAKER: A resettable safety device in the service panel which cuts off current automatically to prevent excess current flow.

CONDUIT: Protective pipe through which wiring is run.

DIMMER SWITCH: A device to regulate the brightness of lights.

DOORBELL: A device used to signal when visitors are at the door.

ELBOWS: L-shaped fittings used in running conduit around corners.

ELECTRICITY CONSUMPTION: The amount of electricity used by an appliance on an hourly basis.

EXTERIOR LIGHTING: Lighting used outdoors.

FILL LIGHT: Overall even light in a room.

FUSE: A replaceable safety device to prevent excess current flow.

GROUND: Connecting circuit components to the ground (earth) for safety.

GROUND-FAULT INTERRUPTER: A very sensitive circuit breaker used as a safety device while using electrical tools.

HICKEY: Adapter for attaching light fixtures to certain ceiling boxes.

HOT WIRE: A wire carrying an electrical current.

INCANDESCENT BULB: A bulb in which a filament is heated to give off light.

INSULATION: A material that blocks the flow of current.

JUNCTION BOX: A metal box used for joining circuits.

KILO-WATT HOUR: A unit of electrical energy which is used to tell how much current is used in one hour.

KNOCKOUT: A removable part of an outlet box which is used for cable entry.

NEUTRAL WIRE: A grounded wire which usually has no voltage.

OUTLET BOX: An enclosure in which wall switches, receptacles, etc. are installed.

PILOT-LIGHT SWITCH: A switch that glows when the power is on.

RECEPTACLE: Outlet into which electrical lights, etc. are plugged.

SAFETY GOGGLES: Glasses worn to protect the eyes from injury due to flying materials, bright lights, etc.

SERVICE ENTRANCE: Place at which a utility company's wires enter a house.

SERVICE HEAD: Part of the service entrance where a utility company's wires are attached to the house.

SERVICE PANEL: Box containing circuit breakers or fuses. Serves as a container for the main cut off switch.

SHORT CIRCUIT: When current does not flow in the normal circuit, but flows directly to ground without doing any work.

SPLICING: To join or connect wire at the ends.

STAR DRILL: A chisel-type tool used for drilling holes in masonry.

STARTER: A part needed to make some fluorescent lamps light.

STRAP: A bar-type metal strip used as a fastener for light fixtures.

WALL SWITCH: An electrical device that allows you to control the power to a ceiling light, wall receptacle, etc.

TERMINAL: Point on an electrical wire, etc., at which an electrical connection is made.

TIMER SWITCH: A switch with a built-in electrical clock to turn appliances on or off at certain times.

TIMER SWITCH: Switch that allows control of power from two locations.

TRANSFORMER: An electrical device used to raise or lower voltage.

UNDERWRITERS' LABORATORIES, INC.: A testing organization which checks electrical devices to make sure they are free of defects that can cause fire or shock.

VOLT: Unit of electrical pressure.

OHM: A unit of electrical resistance.

WATT: Indicates the rate at which a device can convert current to other forms of energy such as heat, etc.

COLOR CODING: A system for identifying wires by color.

WIRE NUT: Device for connecting wires together.

Tools for Basic Wiring



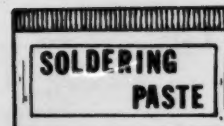
**ELECTRIC
SOLDERING IRON**



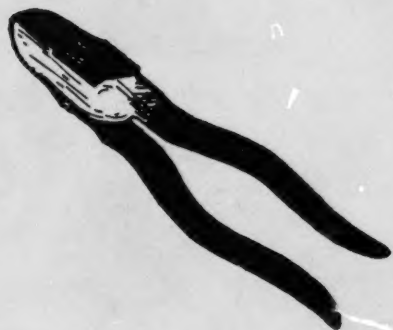
**ELECTRIC
SOLDERING GUN**



EXPANDING BIT



SOLDERING PASTE



SIDE CUTTING PLIERS



CHAIR NOSE PLIERS



LINEMAN'S PLIERS



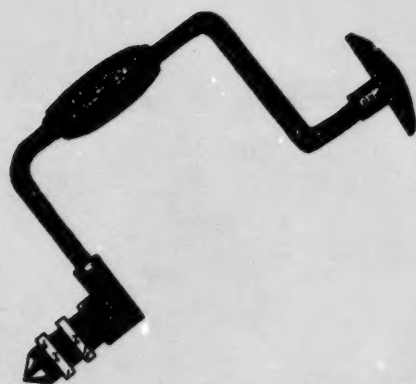
LONG NOSE PLIERS



WOOD CHISEL



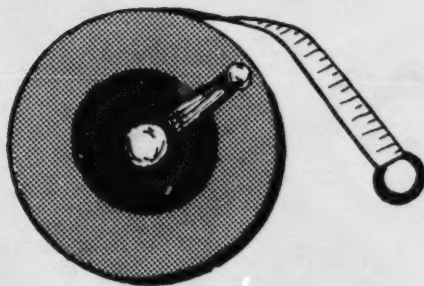
CLAW HAMMER



RATCHET BRACE



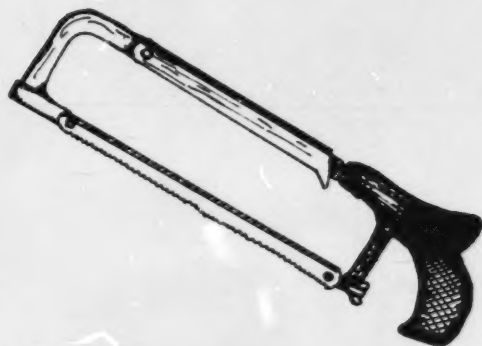
SLIP JOINT PLIERS



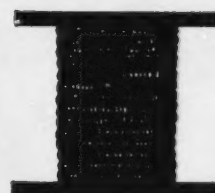
**STEEL FISH TAPE
AND REEL**



CONDUIT BENDER



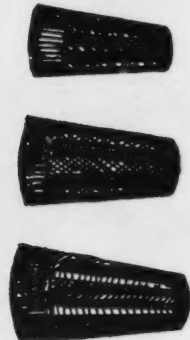
HACKSAW



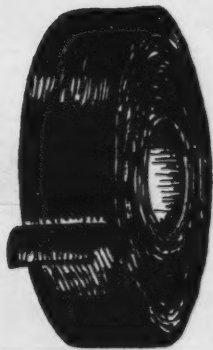
COIL OF SOLDER



TEST LIGHT



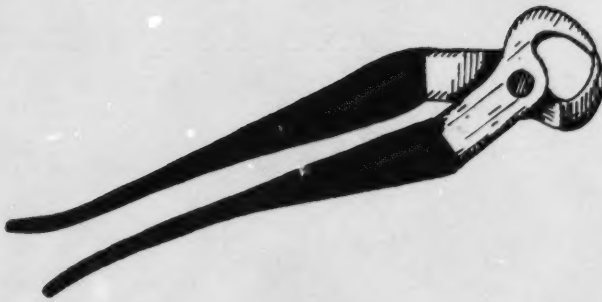
WIRE NUTS



ELECTRICIAN'S TAPE



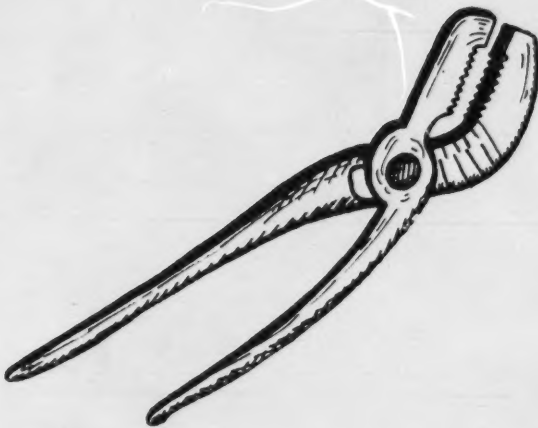
FUSE PULLER



BULL NOSE PLIERS



OBLIQUE PLIERS



CHANNELLOCK PLIERS



LINEMAN'S HAMMER



STUBBY SCREWDRIVER



STEEL TAPE



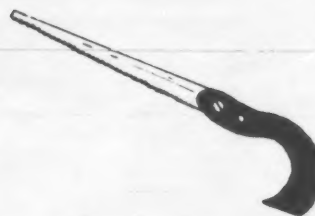
SCREWDRIVER BIT



MULTIPURPOSE TOOL



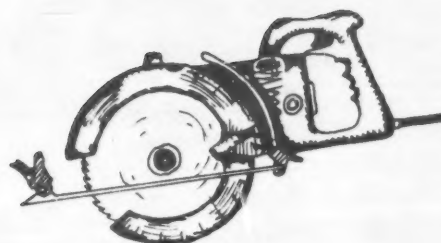
PIPE CUTTER



KEY HOLE SAW



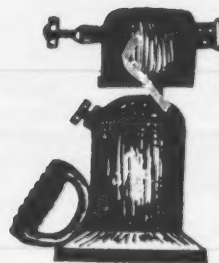
PIPE REAMER



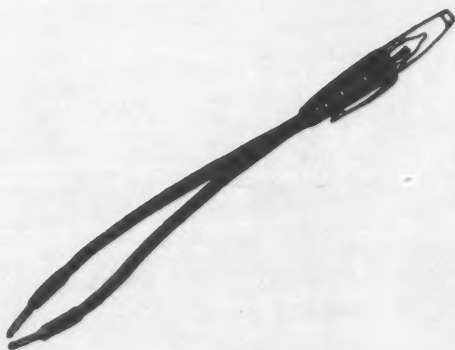
ELECTRIC POWER SAW



BALL-PEEN HAMMER



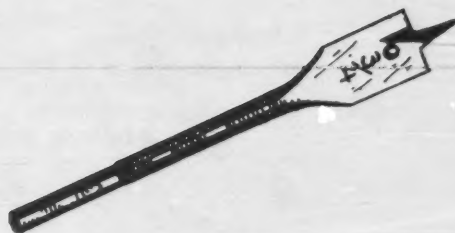
BLOW TORCH



VOLTAGE TESTER



ELECTRIC DRILL



SPADE BIT



METAL SHEARS



PROPANE TORCH



6 FOOT FOLDING RULE



**FLAT BLADE
SCREWDRIVER**



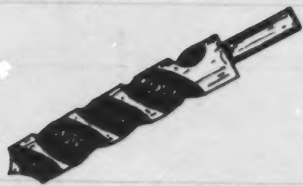
**PHILLIPS
SCREWDRIVER**



DIAGONAL PLIERS



AUGER BIT



MASONRY BIT



STEEL TWIST BIT

COMPUTATIONAL SKILLS FOR Basic Wiring

Addition:

$1 \frac{1}{3}$	$2 \frac{3}{4}$	$4 \frac{7}{8}$	$5 \frac{1}{2}$	$3 \frac{1}{2}$	$19 \frac{7}{16}$	$46 \frac{1}{8}$
$+2 \frac{2}{3}$	$3 \frac{1}{2}$	$6 \frac{7}{8}$	$6 \frac{1}{4}$	$9 \frac{1}{2}$	$17 \frac{3}{16}$	$55 \frac{3}{8}$

123	2,320	12.88	1.67	.06	.92	56
56	199	11.22	.09	.07	.09	43
						7
						19

132		
88	$\frac{1}{2}$	$11 \frac{5}{16}$
11	$\frac{3}{4}$	$6 \frac{1}{4}$
121	$\frac{1}{3}$	$3 \frac{3}{8}$

Subtraction:

18	10.3	$11 \frac{1}{2}$	$8 \frac{3}{8}$	$22 \frac{3}{4}$	$13 \frac{11}{16}$
-7	6.8	$3 \frac{1}{4}$	$4 \frac{5}{8}$	$6 \frac{1}{2}$	$2 \frac{3}{16}$

$\frac{1}{67}$	.92	23.04	16.50	112.62	110.17
.09	.09	3.97	8.51	99.73	109.79

Multiplication:

$15 \times 3 =$

$2.3 \times 6.8 =$

$1/4 \times 1/2 =$

$22 \times 22 =$

$9.9 \times 13.4 =$

$8 \times 9.5 =$

$11 \times 110 =$

$11.5 \times 16 =$

$12 \times 11 =$

Division:

$4 \div 2 =$

$129.6 \div 10 =$

$25.5 \div 5 =$

$16 \div 2 =$

$44 \div 12 =$

$25.5 \div 15 =$

$36 \div 6 =$

$116 \div 36 =$

$1080 \div 33 =$

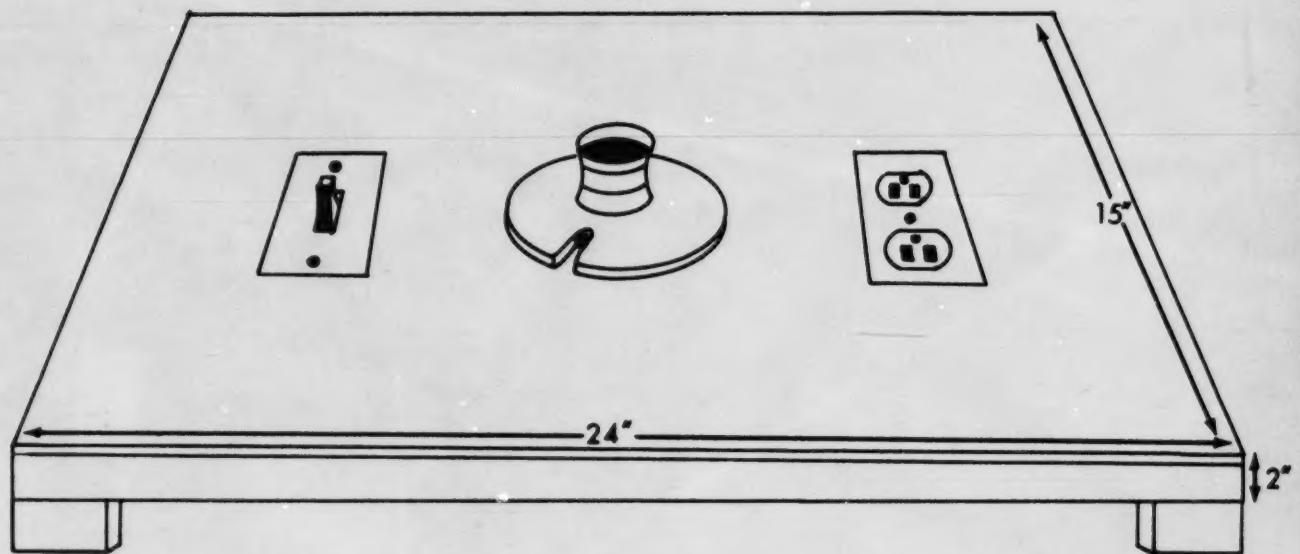
Reading Problems

1. Volts $\times$ Amperes = Watts. A 120 volt motor requires 4 amperes of current. How many watts of electricity does it use?
2. Watts $\div$ Volts = Amperes. A 120 volt iron uses 1200 watts. How many amperes does it require?
3. A wiring job requires 30 feet of 12/2 cable at 20 cents per foot, 3 wall boxes at 60 cents each, 3 wall switches at 89 cents each, and 3 switch covers at 15 cents each. What is your total cost for these materials?
4. Number 10 copper wire will carry 30 amperes, #12 wire will carry 20 amperes and #14 wire will carry 15 amperes. You have an electrical appliance which requires 26 amperes of current. What # wire would you use? Why?
5. Start with the dial on the left and write down the number the pointer has just passed.



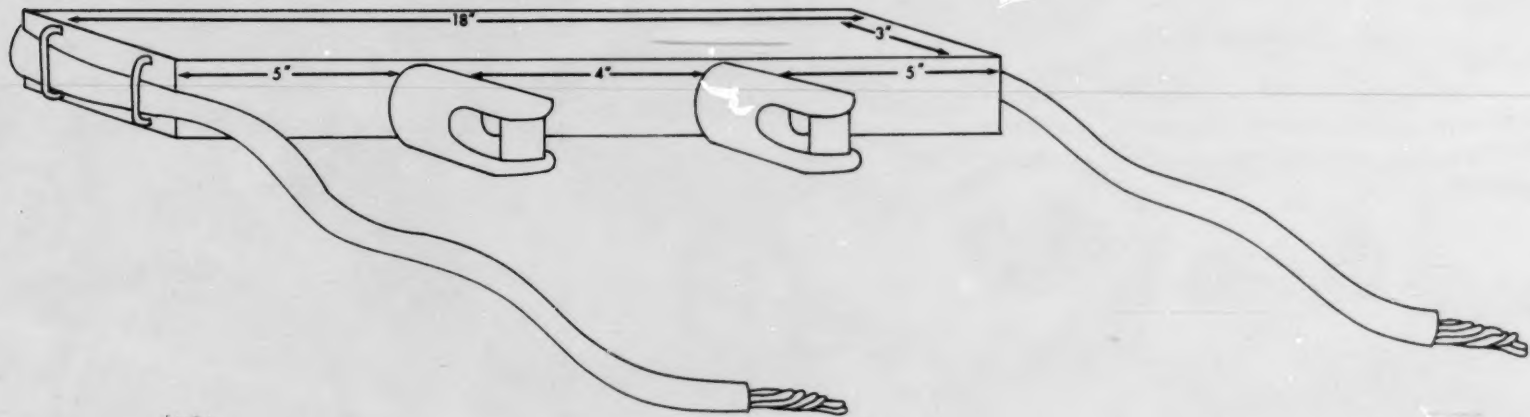
6. You work as an electrician's helper at \$4.00 an hour. You worked 3 hours on Monday, $5\frac{1}{2}$ hours Tuesday, and 10 hours Friday. How much money did you earn?
7. The minimum wage rate is \$3.20 an hour. An electrician offers you a salary of \$125.00 per week for 48 hours of work. Is this a fair salary? Why?

Appendix A



ELECTRICAL WIRING MOCKUP

Appendix B



ENTRANCE CABLE ATTACHMENT